Sudbury Neutrino Observatory, Monte-Carlo Simulation and Background Studies of the PSUP

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The anticipated solar neutrino signal rates of a few tens of events per day require a low background environment for SNO. There are two principal sources of background: cosmic rays and radiation produced by naturally occuring radionuclides. It is expected that the most significant sources of background lie within the detector components themselves. One part is due to the γ's and β's from the Thorium and Uranium chains. The second component is due to the high-energy γ's from the PMT's, their support structure (PSUP) and the SNO cavity. These γ-rays can have energies exceeding 10 MeV and are produced by $(\alpha, p\gamma)$ or by (n, γ) reactions [1].

Since the LBNL group designed and supplied the PSUP[2], we developed here a much improved version of a Monte-Carlo simulation for the PSUP geodesic frame with the SNOMAN code [2]. The exact geometry has not been included into SNOMAN until now.

Two cases were developed to simulate high-energy γ's coming from the PSUP. The first used a shell of water at radius $900 \ldots 910$ cm as the source of 9 MeV γ's. Care was taken to avoid an overlap with other components in this region. The second case placed the shell more correctly at a radius of $883.9 \ldots 894.1$ cm. The monoenergetic γ's are distributed isotropically within these shells. We then investigated how many events with an energy greater than 3 MeV were reconstructed as originating inside the D_2O.

In fig.1 the reconstructed position versus the generated point of the Cerenkov light is shown for the second case. Mostly the Cerenkov light creation is outside of the D_2O. In the first case with the source shell behind the panel zone 8.7 % of all generated photons resulted in a detected

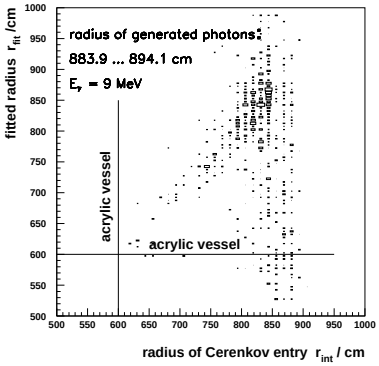

Figure 1: Fitted position of Cerenkov light vs. production point for case 2

signal. From these entries 9.6 % are fitted inside the D_2O with the standard time fitter and 2 % had a fitted energy $E \geq 3$ MeV. Therefore of all high-energy γ-rays originating in the PSUP 0.2% are fitted in the D_2O with energy greater than 3 MeV. Tab.1 summarizes and compares the results of both cases. We are continuing our

shell range	case 1	case 2
hits	8.7%	13.1%
fitted in D_2O	9.6%	8.9%
$E_{fit,hits} \geq 3$ MeV	2.0%	2.8%
$E_{fit,gen} \geq 3$ MeV	0.2%	0.4%

Table 1: Results from PSUP shell simulation

Monte-Carlo simulations for background studies for the CC and NC spectra with the improved fitters and PSUP geometry.

References

[1] NIM A364 (1995) 317-327

[2] NSD Annual Report, 1995, p.99ff

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